

Fig. 1

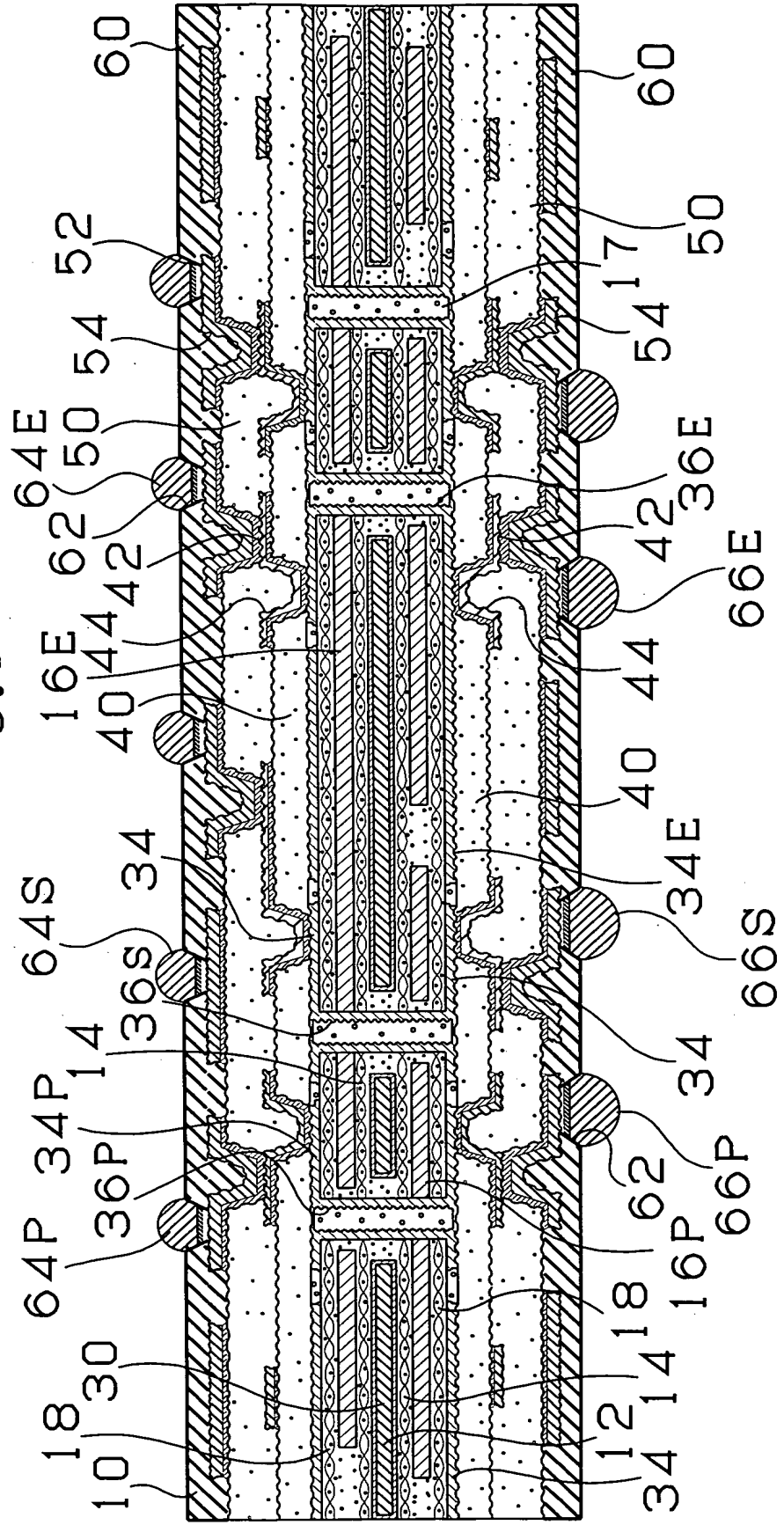
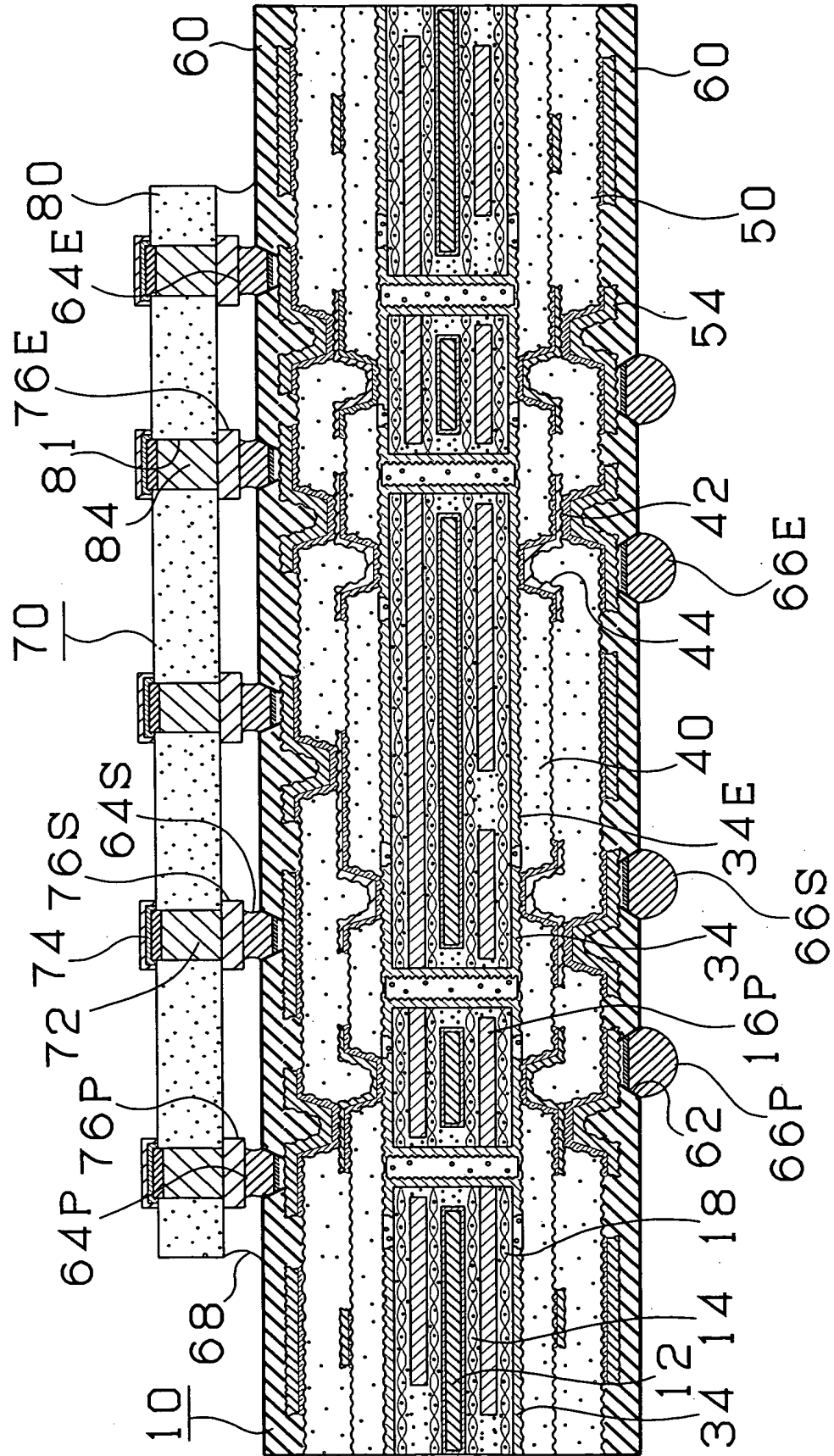
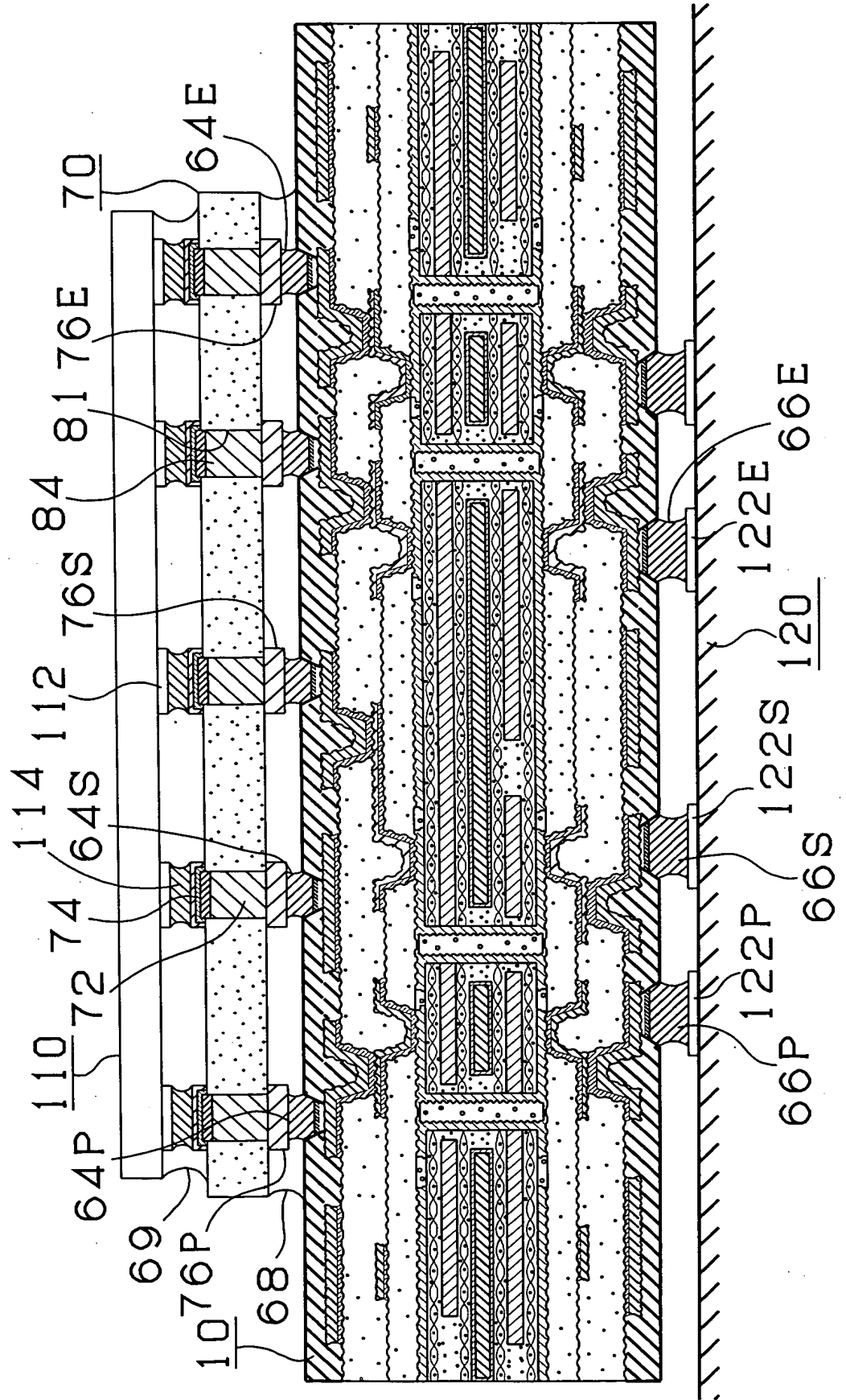


Fig.2



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Fig.3

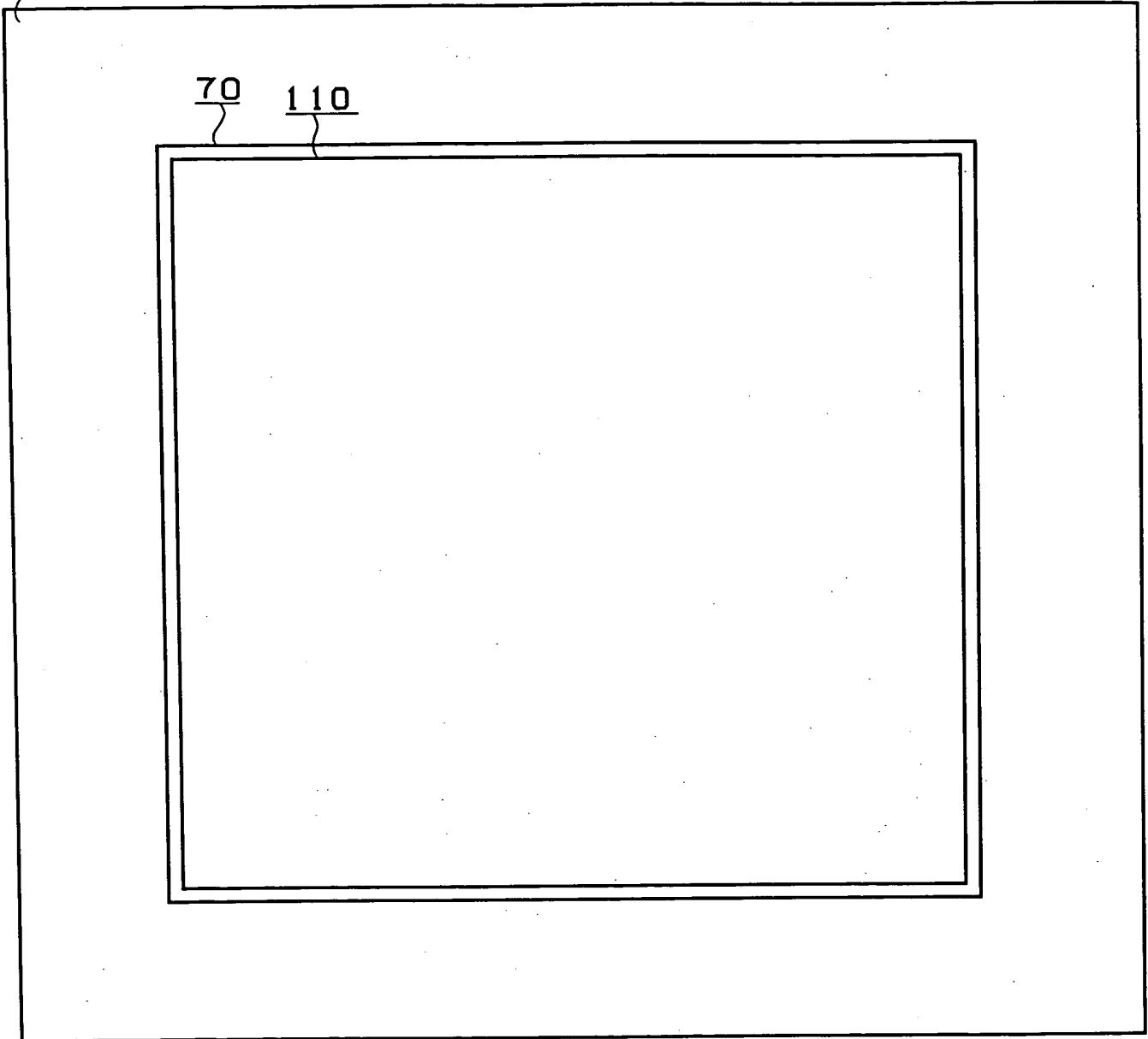


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Fig.4

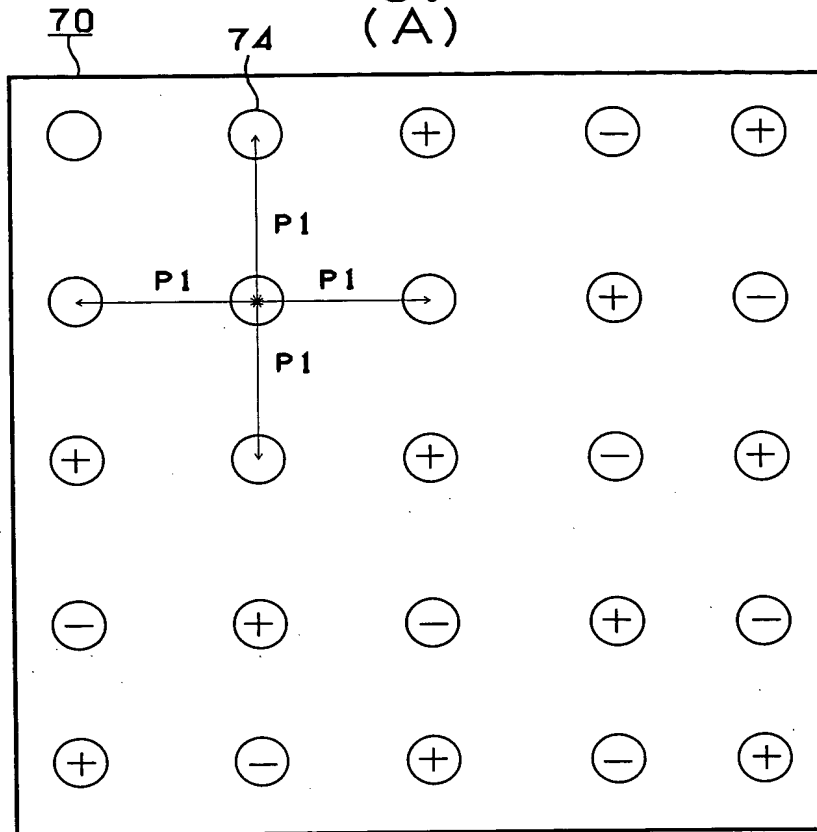
10

70

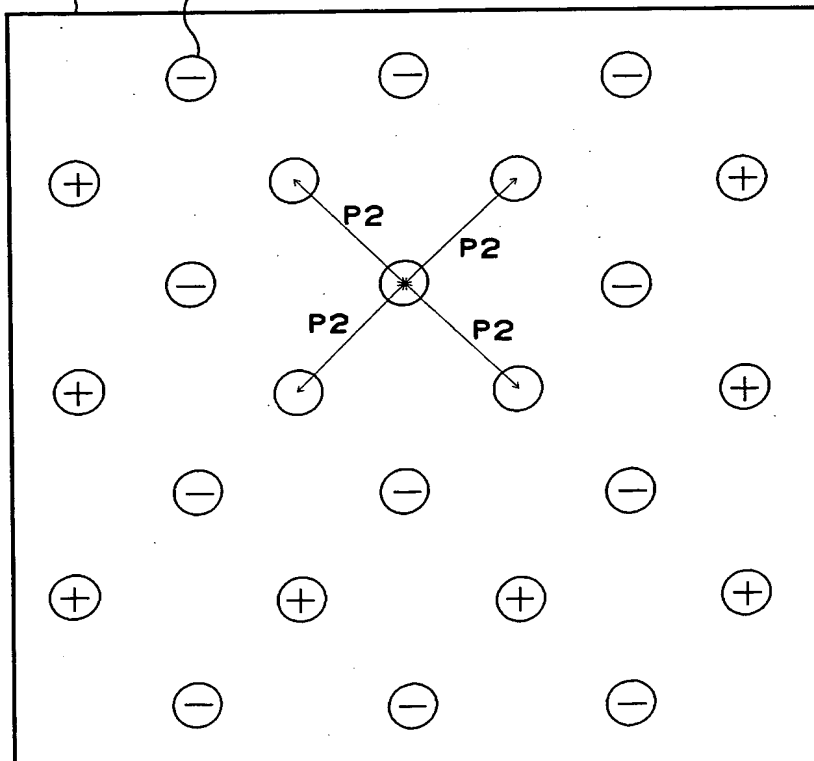
110



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Fig. 5
(A)

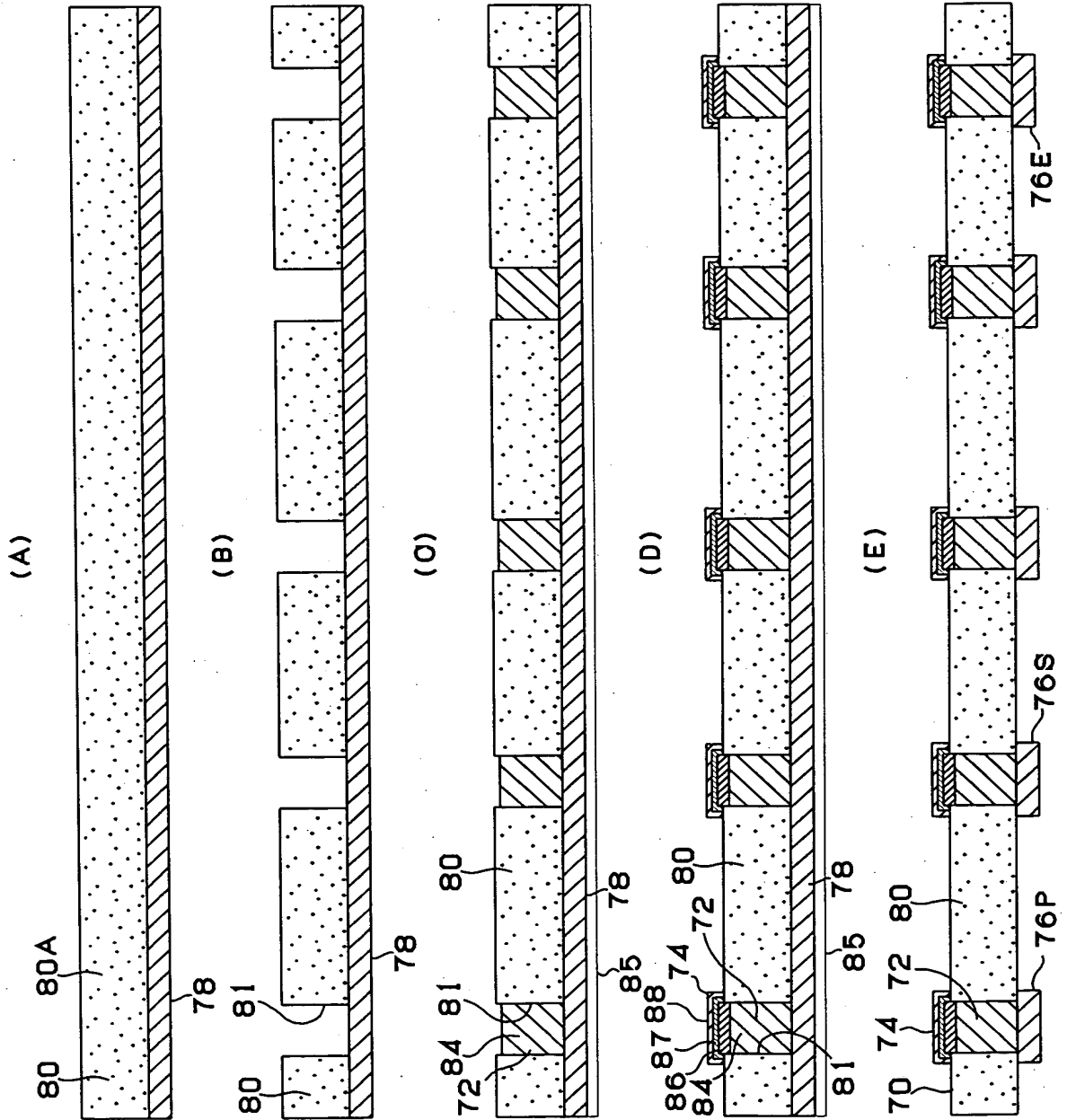


70 74 (B)



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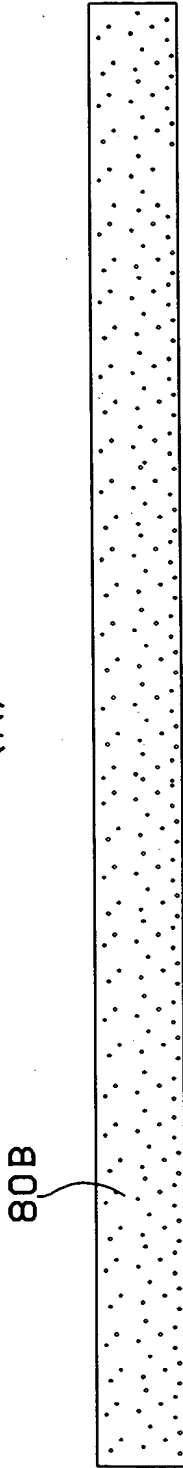
Fig. 6



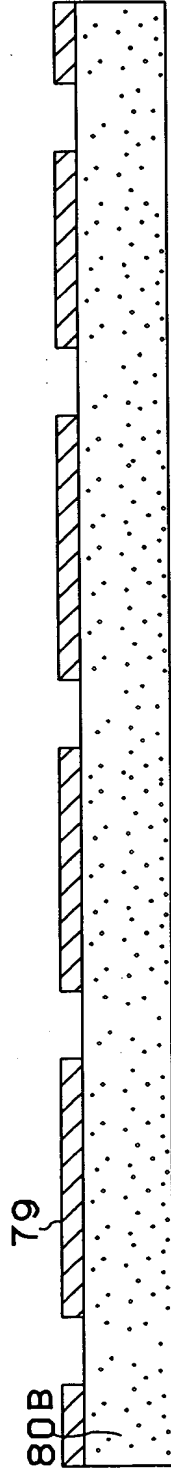
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Fig. 7

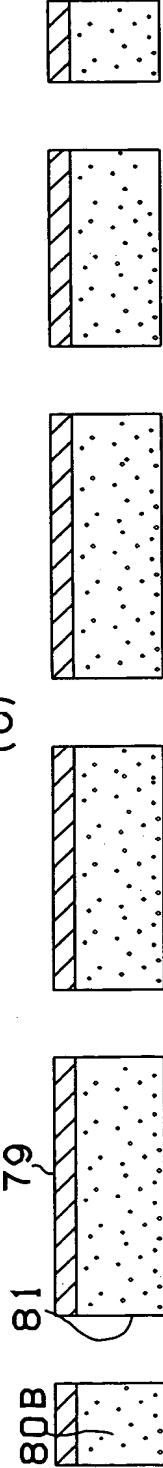
(A)



(B)



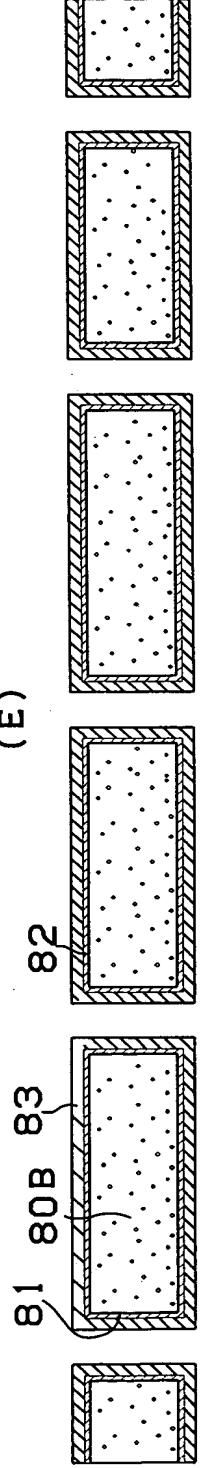
(C)

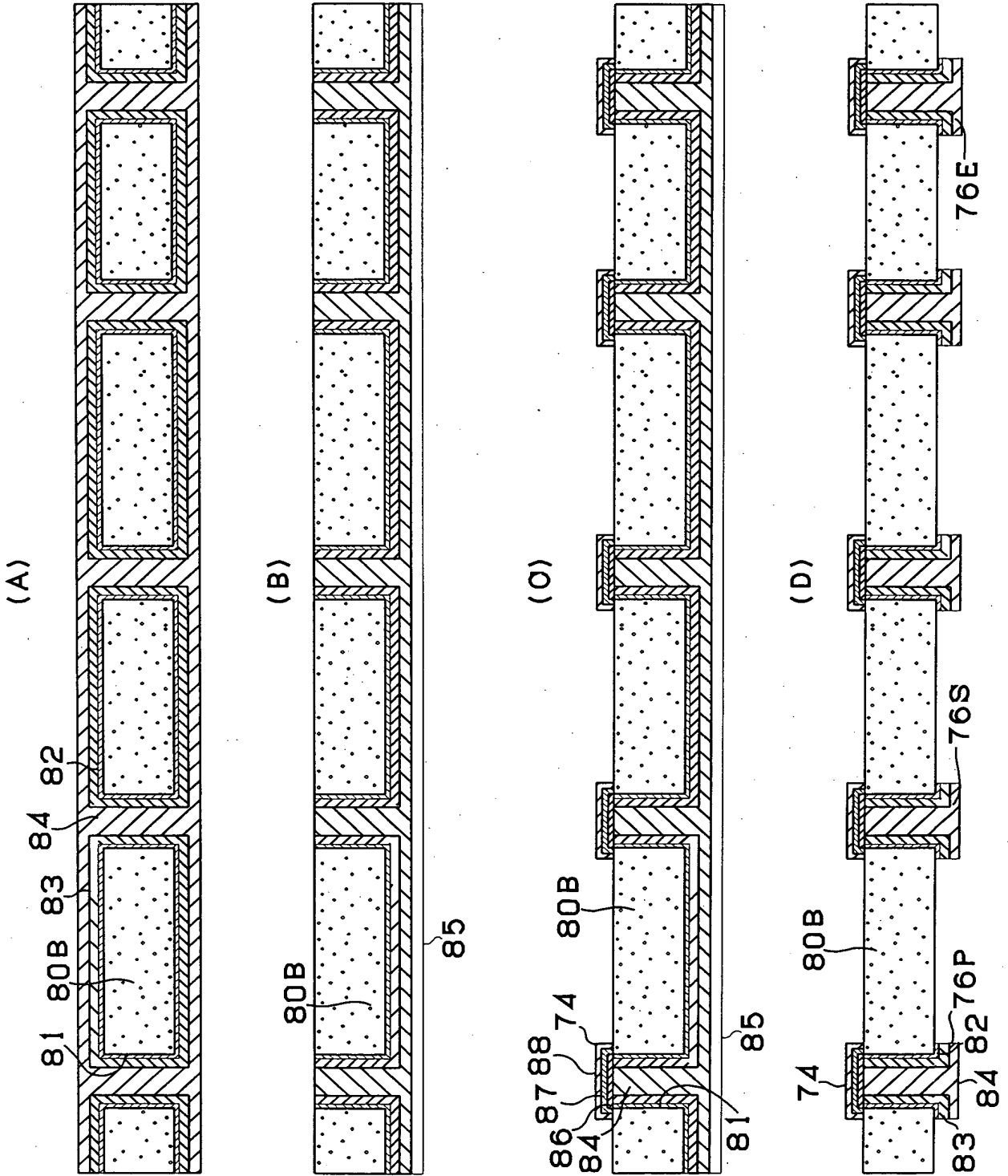


(D)



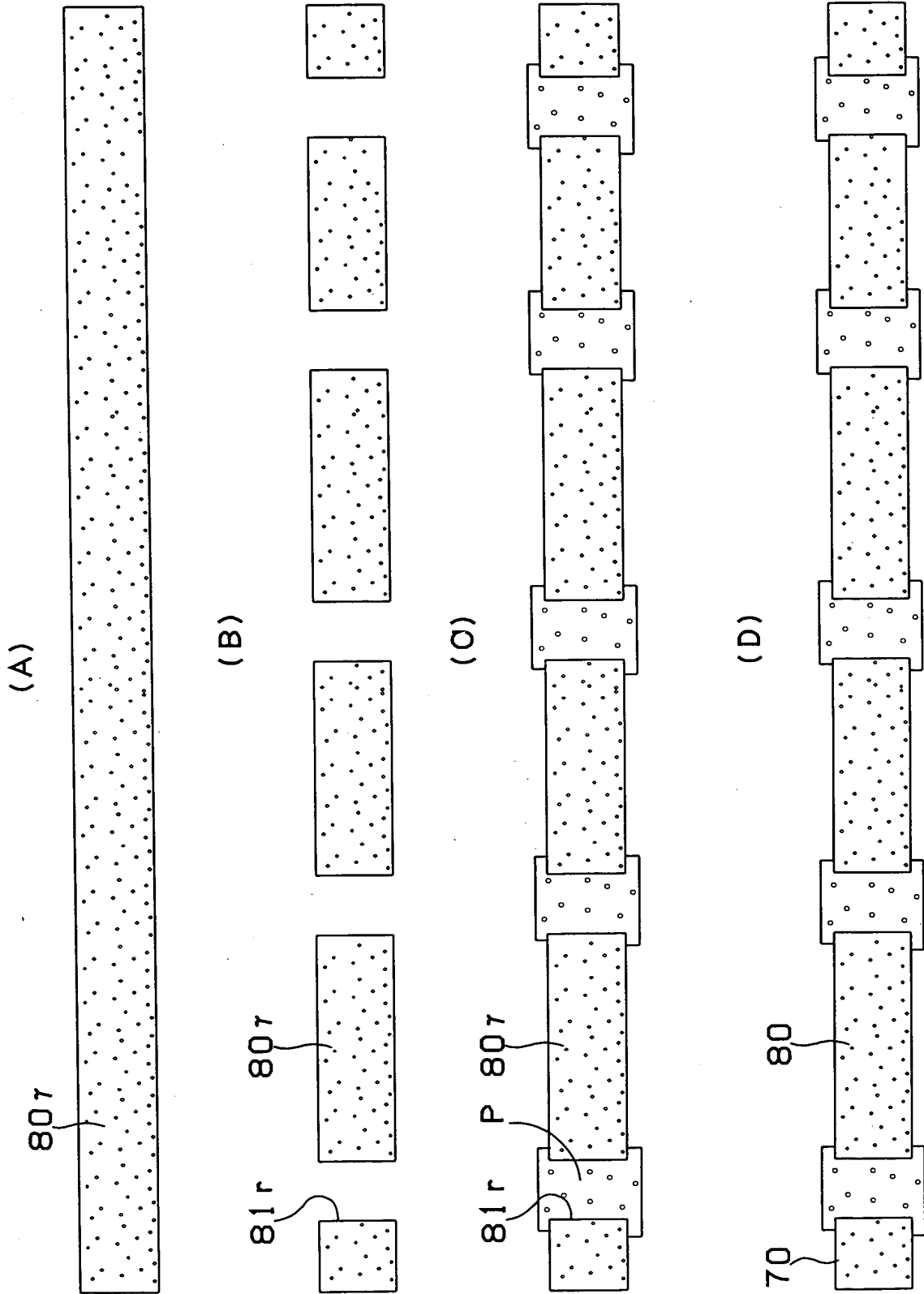
(E)





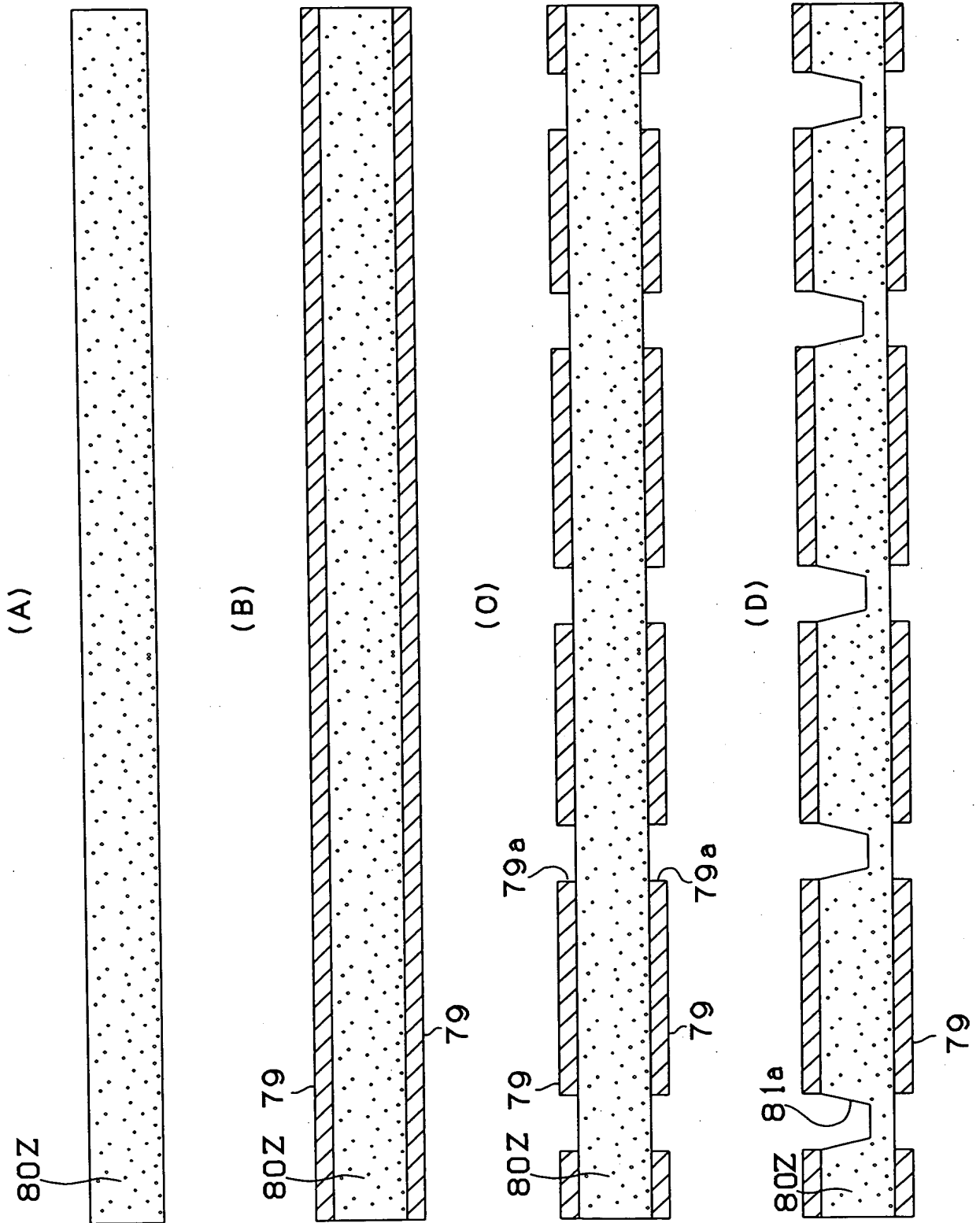
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Fig. 9



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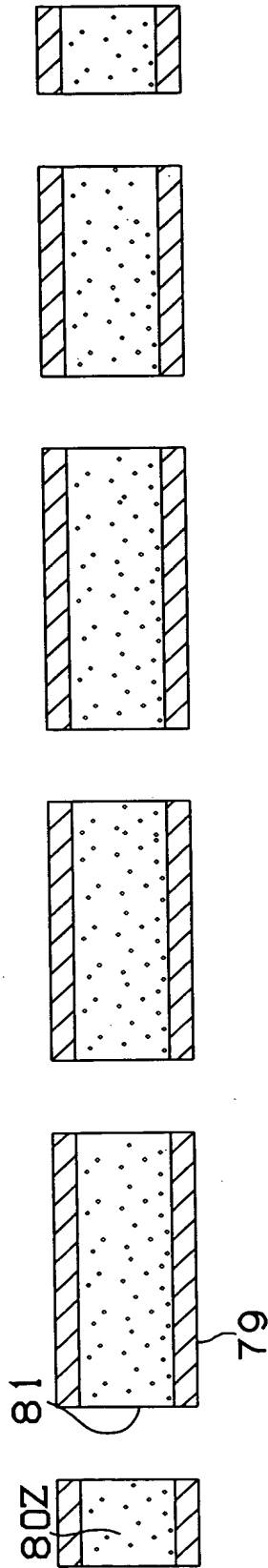
Fig. 10



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Fig. 11

(A)



(B)

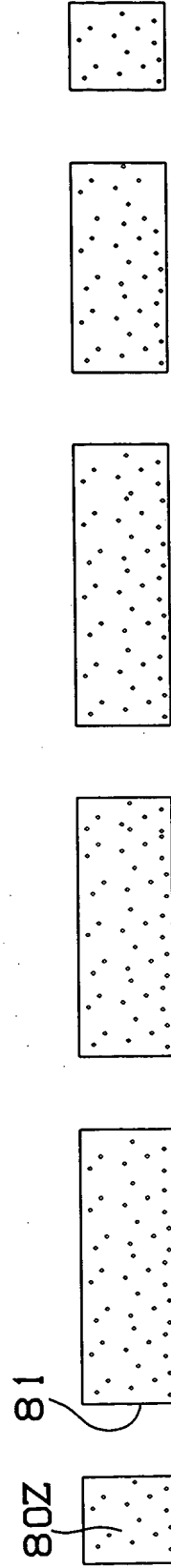


Fig. 12

	Young's modulus of insulation base material (Gpa)	Thickness of insulation base material (μmt)	Size of insulation base material (mm x mm)	Diameter of through hole formed in insulation base material (μm)				Change amount of conduction resistance after heat cycle test (%)			
				Diameter of opening in an end face	Diameter of opening in other end face	Diameter of minimum opening of through hole		After 500 cycles	After 1000 cycles	After 1500 cycles	After 2000 cycles
Embodiment1	55	50	32	125	125	125		○	×	×	×
Embodiment2	55	64	32	125	125	125		○	△	×	×
Embodiment3	55	100	32	125	125	125		○	○	×	×
Embodiment4	55	400	32	125	125	125		○	○	×	×
Embodiment5	55	1000	32	125	125	125		○	○	×	×
Embodiment6	55	1500	32	125	125	125		○	△	×	×
Embodiment7	200	50	32	125	125	125		◎	○	×	×
Embodiment8	200	64	32	125	125	125		◎	○	○	×
Embodiment9	200	100	32	125	125	125		◎	◎	◎	◎
Embodiment10	200	400	32	125	125	125		◎	◎	◎	◎
Embodiment11	200	1000	32	125	125	125		◎	◎	◎	◎
Embodiment12	200	1500	32	125	125	125		◎	◎	○	×
Embodiment13	440	50	32	125	125	125		◎	○	×	×
Embodiment14	440	64	32	125	125	125		◎	○	○	×
Embodiment15	440	100	32	125	125	125		◎	◎	◎	◎
Embodiment16	440	400	32	125	125	125		◎	◎	◎	◎
Embodiment17	440	1000	32	125	125	125		◎	◎	◎	◎
Embodiment18	440	1500	32	125	125	125		◎	◎	○	×
Embodiment19	200	100	24	125	125	125		◎	◎	◎	◎
Embodiment20	200	100	20	125	125	125		◎	○	×	×
Embodiment21	200	100	40	125	125	125		◎	○	×	×
Embodiment22	310	400	32	125	125	125		○	○	×	×
Embodiment23	310	50	32	125	125	125		◎	○	×	×
Embodiment24	310	64	32	125	125	125		◎	○	○	×

Fig. 13

	Young's modulus of insulation base material (Gpa)	Thickness of insulation base material (μmt)	Size of insulation base material (mm x mm)	Diameter of through hole formed in insulation base material (μm)				Change amount of conduction resistance after heat cycle test(%)			
				Diameter of opening in an end face	Diameter of opening in other end face	Diameter of minimum opening of through hole		After 500 cycles	After 1000 cycles	After 1500 cycles	After 2000 cycles
Embodiment25	310	100	32	125	125	125		⊙	⊙	⊙	⊙
Embodiment26	310	400	32	125	125	125		⊙	⊙	⊙	⊙
Embodiment27	310	1000	32	125	125	125		⊙	⊙	⊙	⊙
Embodiment28	310	1500	32	125	125	125		⊙	⊙	⊙	⊙
Embodiment29	55	50	32	125	125	125		⊙	⊙	⊙	⊙
Embodiment30	55	64	32	125	125	125		⊙	⊙	⊙	⊙
Embodiment31	55	100	32	125	125	125		⊙	⊙	⊙	⊙
Embodiment32	55	400	32	125	125	125		⊙	⊙	⊙	⊙
Embodiment33	55	1000	32	125	125	125		⊙	⊙	⊙	⊙
Embodiment34	55	1500	32	125	125	125		⊙	⊙	⊙	⊙
Embodiment35	65.5	50	32	125	125	125		⊙	⊙	⊙	⊙
Embodiment36	65.5	64	32	125	125	125		⊙	⊙	⊙	⊙
Embodiment37	65.5	100	32	125	125	125		⊙	⊙	⊙	⊙
Embodiment38	65.5	400	32	125	125	125		⊙	⊙	⊙	⊙
Embodiment39	65.5	1000	32	125	125	125		⊙	⊙	⊙	⊙
Embodiment40	65.5	1500	32	125	125	125		⊙	⊙	⊙	⊙
Embodiment41	65.5	50	32	125	125	122.5		⊙	⊙	⊙	⊙
Embodiment42	65.5	50	32	125	125	25.0		⊙	⊙	⊙	⊙
Embodiment43	65.5	50	32	125	125	25.0		⊙	⊙	⊙	⊙
Experimental Example 1	200	100	32	125	125	125		⊙	⊙	⊙	⊙
Experimental Example 2	200	100	32	125	125	125		⊙	⊙	⊙	⊙
Experimental Example 3	200	100	32	60	60	60		⊙	⊙	⊙	⊙
Experimental Example 4	200	100	32	60	60	60		⊙	⊙	⊙	⊙

Fig. 14

	Young's modulus of insulation base material (Gpa)	Thickness of insulation base material (μmt)	Size of insulation base material (mm x mm)	Diameter of through hole formed in insulation base material (μm)				Change amount of conduction resistance after heat cycle test (%)			
				Diameter of opening in an end face	Diameter of opening in other end face	Diameter of minimum opening of through hole		After 500 cycles	After 1000 cycles	After 1500 cycles	After 2000 cycles
Comparative Example1	50	100	32	125	125	125		x	x	x	x
Comparative Example2	470	100	32	125	125	125		x	x	x	x
Comparative Example3	200	45	32	125	125	125		x	x	x	x
Comparative Example4	200	1600	32	125	125	125		x	x	x	x
Comparative Example5	55	50	15	125	125	125		IC cannot be mounted on the insulation material.			
Comparative Example6	55	50	45	125	125	125		Insulation material cannot be mounted on the package substrate.			
Comparative Example7	65.5	50	32	125	125	22.7		O	x	x	x

◎ : $-3\% \leq$ resistance change rate $\leq 3\%$ ○ : $-6\% \leq$ resistance change rate $< -3\%$ and $3\% <$ resistance change rate $\leq 6\%$

△ : $-10\% \leq$ resistance change rate $< -6\%$ and $6\% <$ resistance change rate $\leq 10\%$ X : $-10\% >$ resistance change rate and $10\% <$ resistance change rate unacceptable if $\pm 10\%$ is exceeded

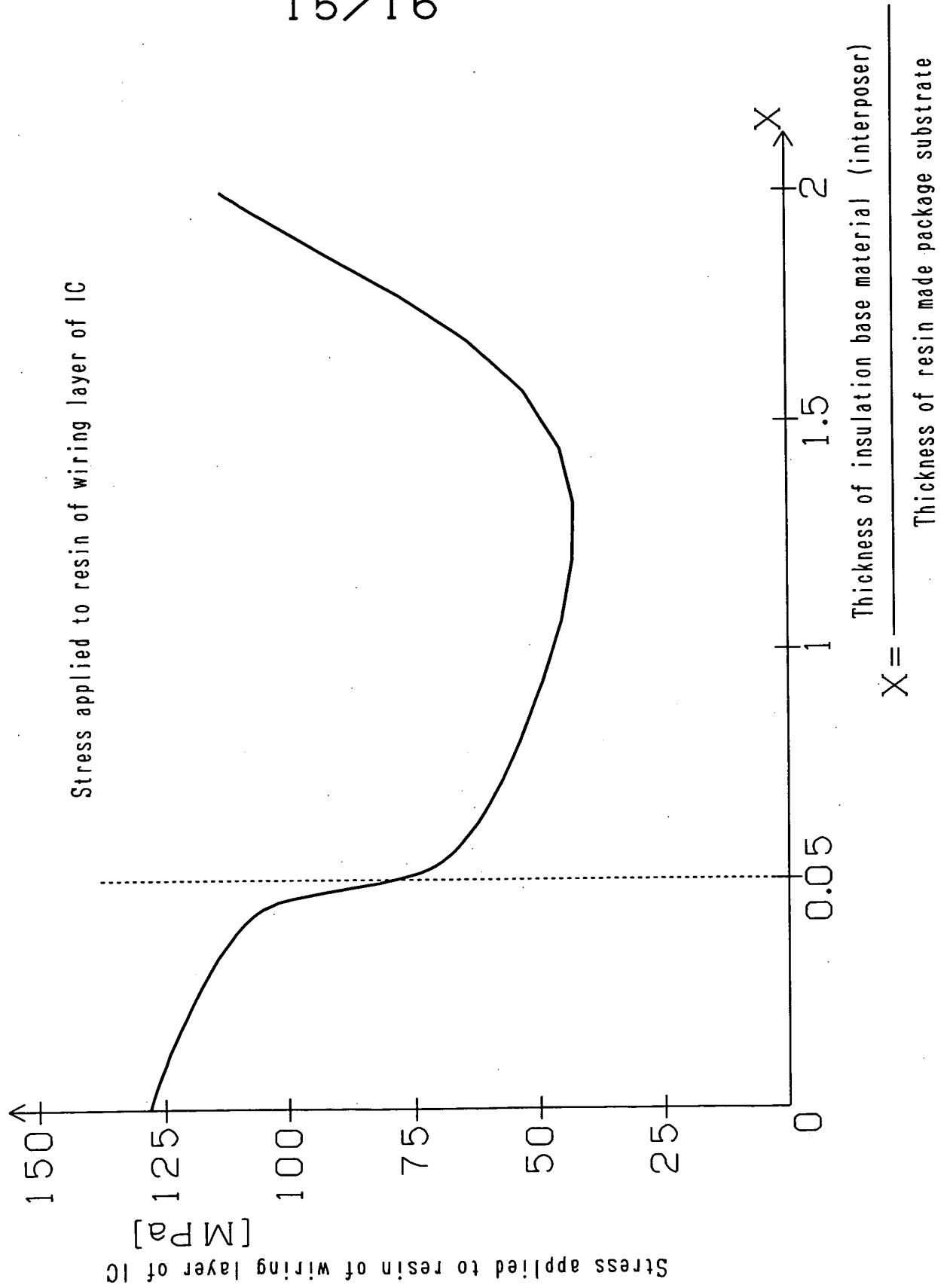
Resistance change rate (%) = $|$ resistance value after heat cycle - initial value $|$ / initial value x 100 Thickness of package substrate: 1.0mm

Thickness of core of package substrate: 0.8mm External size of package substrate: 40mm x 40mm

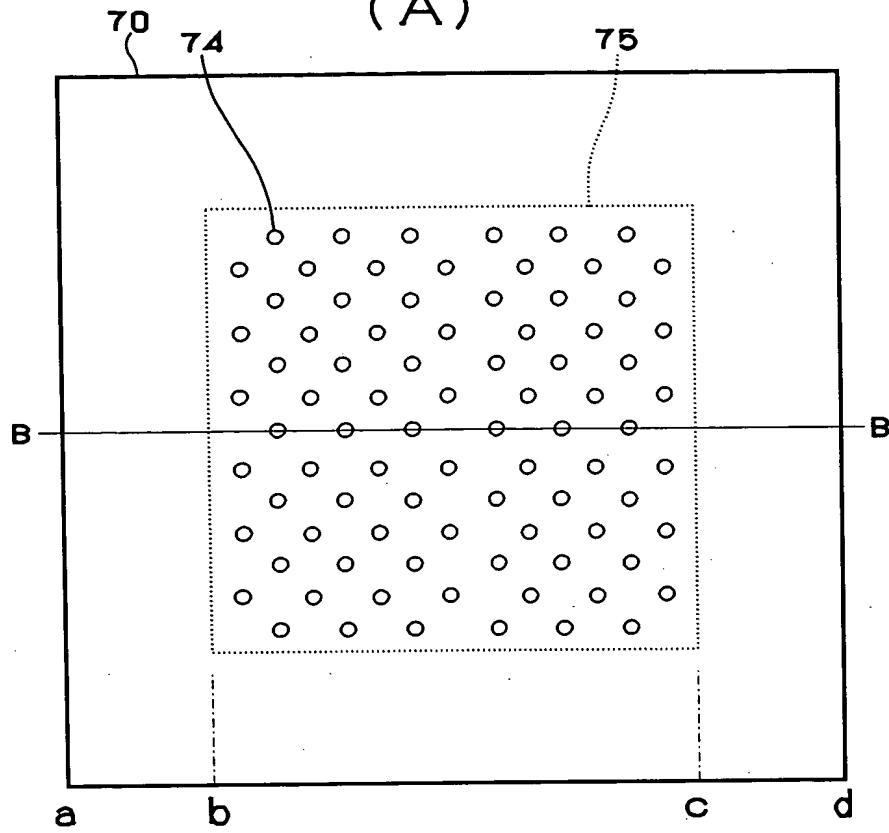
External size of IC: 20mm x 20mm

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Fig.15



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Fig.16
(A)



(B)

